ENTIAT EFFECTIVENESS MONITORING STUDY: MONITORING THE EFFECTIVENESS OF HABITAT RESTORATION ACTIONS IN THE LOWER ENTIAT RIVER

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Summary Description

The Entiat Effectiveness Monitoring Study will measure the extent to which the Bridge-to-Bridge Habitat Restoration Project in the lower Entiat River affects (a) fish habitat, (b) fish habitat utilization, and (c) the productivity of salmonid fishes in the Entiat Subbasin, and will test aspects of the *Monitoring Strategy for the Upper Columbia Basin* (Hillman 2004) that pertain to effectiveness monitoring. Surveys of fish habitat and fish habitat utilization supported by this Study will be synthesized with separately-funded, yet compatible, agency monitoring programs to include all of the indicators specified for study in Hillman (2004). Coordination with landowners and the local Watershed Planning Unit are built into this Study design.

Ideally, the Study will be implemented over a 10 year period. This duration is dependent upon funding. To start, a minimum of five years participation has been solicited from willing private landowners. An extended monitoring time frame is necessary to account for at least two salmonid generations (4-5 years per generation), to capture pre and post-restoration project conditions, interannual variability, long-term channel adjustments resulting from the restoration project, and possible changes to restoration project features that might arise from periodic factors like large runoff events.

This Study capitalizes on the unique effectiveness monitoring opportunity in the Entiat Subbasin. The Entiat Bridge-to-Bridge Project is sufficiently large and designed to help fix the appropriate salmon habitat limiting factors. It will likely provide measurable contributions to fish habitat, habitat utilization, and the productivity of salmonids in the Entiat Subbasin. Furthermore, this discrete reach restoration effort is generally not confounded by other actions and land use impacts to the extent found in other Subbasins. Finally, this Study firmly places monitoring within the Entiat Subbasin in the framework described by the *Monitoring Strategy for the Upper Columbia Basin*, and helps implement monitoring actions recommended in the Entiat watershed plan (CCCD 2004).

The initial implementation of this study is being funded primarily by the Bonneville Power Administration (BPA) through a project managed by National Oceanic and Atmospheric Administration (NOAA). This larger project, called the Integrated Status and Effectiveness Monitoring Program (ISEMP), is designed to suggest better ways to monitor the status and trends of fish and their habitats as well as the effectiveness of fish restoration measures. In the Entiat, additional data is being collected by cooperating agencies (see Table 1) under separate funding.

Table 1. A description of several study elements of the Entiat Effectiveness Monitoring Study.

Study Element - Initial Study Period (2005-2007)	Description
1) Coordination	Chelan County Conservation District will coordinate: the implementation of the restoration project; landowner and Planning Unit outreach; and annual project reporting.
2) Data synthesis and technical reporting	The monitoring results of all indicators (elements 3 through 9) will be synthesized into a final report at the end of the three year initial study period to describe initial results of the Entiat Effectiveness Monitoring Study.
3) Performance Monitoring	Chelan County Conservation District will coordinate landowner outreach to enable USFWS and UCSRB RTT monitoring partners to establish longitudinal and cross-sectional stream profiles at treatment and control sites with the specific intent to monitor physical changes in the stream channel resulting from restoration project actions. These surveys will elucidate the mechanistic steps between action and resultant physical change but are unsuited for use in biological monitoring. These surveys will also help with adaptive design of future actions.
4) Parr/Juvenile/Adult habitat use	USFWS will conduct the monitoring of parr/juvenile/adult fish use of habitat within Project treatment and control reaches through seasonal (3 times/year) snorkeling observations.
5) Habitat conditions, channel conditions, riparian conditions, and macroinvertebrate sampling	Protocols described in the Upper Columbia Monitoring Strategy (Hillman 2004) will be used to evaluate treatment and control reaches to explain confounding sources of variability in the fish habitat use data. Complete protocols will be implemented once per year in coordination with the late-July snorkel survey. Two additional habitat surveys of limited scope will be conducted to support snorkel surveys in late February and November.
6) Adults and redds	Historical and on-going surveys of adult/redd abundance and distribution will continue to be implemented throughout the spawning range of target species, including the treatment and control portions of the Project area. Funding for these surveys by USFWS (bull trout, steelhead, spring, summer) are secure.
7) Smolts	USFWS began operation of a smolt trap upstream of the treatment reach in 2004 and will continue this operation indefinitely. Funding for the operation of this trap is secure. No additional funding is needed for this indicator during the initial three year study phase. Additional smolt trapping may be considered depending on the species and life stages found to use new habitat within the treatment reach.
8) Stream flow and water temperature	USFS maintains a longitudinal network of automated thermometers throughout the mainstem Entiat River including meters near treatment and control reaches. USGS maintains three stream gages in the watershed, one near the treatment reach and one in the uppermost control reach. Additional automated thermometers may be deployed by the USFWS at specific monitoring locations.
9) Landscape Classification	Landscape classification required for effectiveness monitoring under the Upper Columbia Monitoring Strategy has been completed by UCSRB and ISEMP.

Background: In 2005, the Chelan County Conservation District (CCCD) on behalf of the Entiat Watershed Planning Unit (EWPU) will begin construction of what may be the largest reach-scale habitat restoration project currently being implemented in the Upper Columbia Basin. This project, known as the "Entiat Bridge-to-Bridge Project" (Project), is funded by Washington Salmon Recovery Funding Board (SRFB) and includes the rewatering and reconnection of relict stream channels with the main river channel, stream grade control, placement of in-stream structures, and riparian planting – all to occur within 1.2 miles of the Entiat River from river mile 3.2 to river mile 4.4. The riparian planting element of the Project will begin in 2005, while the instream structure and side-channel work is scheduled to begin in 2006. The Project addresses what the Upper Columbia Regional Technical Team (RTT) considers to be the primary limiting factor in the lower Entiat – channel complexity– and this project implements one of four simultaneous actions recommended in the RTT's *Upper Columbia Biological Strategy* – "restore habitat diversity and channel function" in the lower river. The Bridge-to-Bridge project is anticipated to increase adult holding habitat, juvenile rearing habitat, and spawning habitat for salmonid species, of which steelhead, spring and summer Chinook salmon, and bull trout may be affected. For instance, the Project intends to increase pool densities from 0.3 to 9.0 pools per mile in an area used by each of these species currently under some level of federal or state protection.

Effectiveness monitoring – the study of how restoration actions affect fish populations and habitat conditions – has been identified by state and federal funding agencies as critical to the development, adaptive management, and accountability of publicly-funded restoration programs. The UCSRB RTT and NOAA Fisheries have identified the construction of this Project as an excellent opportunity to implement an effectiveness monitoring study for several reasons:

Opportunity 1) the Entiat Bridge-to-Bridge Project is sufficiently large and targeted to the appropriate limiting factors that it may provide measurable contributions to fish habitat, habitat utilization, and the productivity of salmonids in the Entiat Subbasin,

Opportunity 2) the RTT and NOAA Fisheries have recently developed a *Monitoring Strategy for the Upper Columbia Basin* which provides a framework for measuring the effectiveness of projects like the Entiat Bridge-to-Bridge Project,

Opportunity 3) monitoring efforts in the Entiat Subbasin by multiple agencies, including U.S. Fish and Wildlife (USFWS), CCCD, and U.S. Forest Service (USFS), are currently being implemented in a way that could be easily structured into a focused effectiveness monitoring study, and

Opportunity 4) the additional resources necessary to coordinate and complete an scientifically-sound effectiveness monitoring study are relatively modest.

The Entiat Watershed Planning Unit supports this effort because effectiveness monitoring was recommended in the Entiat watershed plan, and is complementary to other ongoing

actions. This study will provide valuable information to the EWPU and enable the community to track habitat restoration results and revise strategies, if necessary.

Proposed Entiat Effectiveness Monitoring Study: The RTT, in conjunction with CCCD and other cooperating agencies, proposes an effectiveness monitoring study (Study) for the Bridge-to-Bridge Project that would:

Objective 1) measure the extent to which the Project affects (a) fish habitat, (b) fish habitat utilization, and (c) the productivity for salmonid fishes of the Entiat Subbasin, and

Objective 2) test aspects of the *Monitoring Strategy for the Upper Columbia Basin* that pertain to effectiveness monitoring.

The Study will monitor treatment and control reaches of the Entiat Subbasin, and utilize an ecological landscape classification system that has been recently developed (by BPA and Upper Columbia Salmon Recovery Board) to support effectiveness monitoring, and quantify Project-related changes in several indicators:

Indicator 1) the abundance and distribution of spawning adult steelhead, chinook salmon, and bull trout,

Indicator 2) the complexity of the physical habitat structure (habitat conditions, channel conditions, riparian conditions, and macroinvertebrate community structure) within the Project-area;

Indicator 3) stream flow and water temperature;

Indicator 4) adult and juvenile fish habitat utilization; and

Indicator 5) the number/size of outmigrating juvenile salmonids.

The initial phase of the proposed study would span a three-year time period, beginning in 2005 prior to implementation of the Bridge-to-Bridge Project, and continue through the 2007 field season as the phased Project is implemented. Complete answers to the more challenging research questions (e.g. how has the Project affected salmonid productivity) would likely take at least 10 years (i.e. at least two salmonid generations) to answer, however, continuation of monitoring beyond 2007 is contingent upon funding and ongoing landowner permission and partnership in this effort.

Study Element Details

Survey Sites and Experimental Design

The basic experimental design used for this study is a modified Before-After/Control-Impact design as reviewed in Hillman (2004). Fish and habitat surveys will be conducted at three sites proposed to be treated with new restoration actions in the next few years, and at six sites composed of two types of experimental controls. (Experimental controls are used to provide a baseline against which treated sites can be compared.) We used the Upper Columbia ecological landscape classification system to refine locations of control sites so that general habitat conditions at control and treatment sites are similar.

One set of three experimental controls (which we call "untreated" controls) have been located at sites where no restoration work is anticipated in the near future (5+ years). These sites should change very little during the course of the study and should represent the relatively depressed conditions existing in much of the lower river. The second set of three experimental controls (which we call "preexisting" controls) have been located at sites where restoration treatments have already been completed and are currently providing benefits to fish. These sites also should change very little during the course of the study but should reflect the types of conditions (e.g. complex channels, higher fish densities) that we expect with completed treatments. The way we intend to compare each of these three types of sites is illustrated in Figure 1.

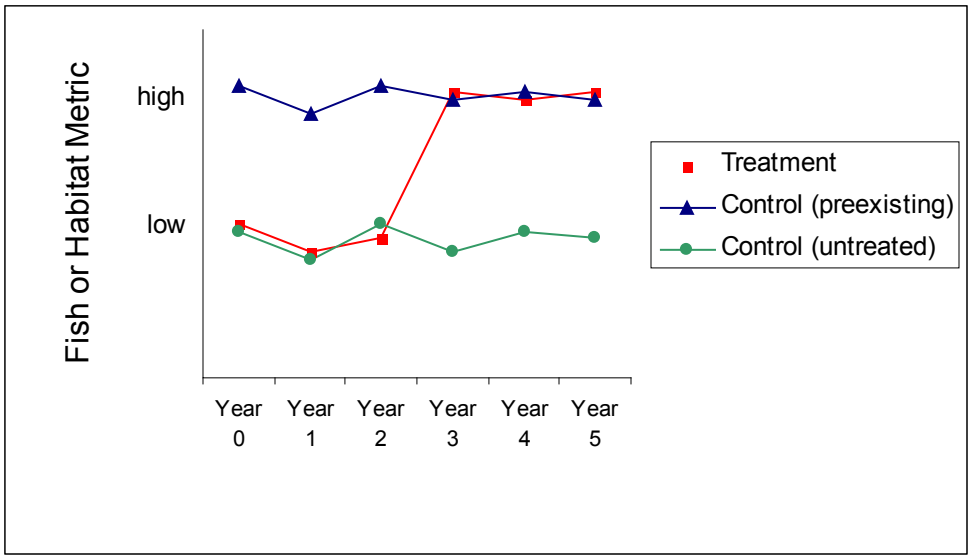

Figure 1. Hypothesized responses of fish or habitat metrics (e.g. fish densities or pool areas, etc.) at three types of study sites. This figure assumes that habitat work is done at the treatment sites after surveys in Year 2. It also assumes that habitat work was done at preexisting control sites prior to Year 0. It also assumes an immediate, persistent response to restoration treatments.

At each sample site, we will survey all possible fish habitat such as main channels and side channels. This includes irrigation canals and fish bypass channels where they abut our sample sites (as they do at 4 sites: the PUD irrigation canal, Knapp-Wham diversion, Hanan-Detwiler, and restored side channel below the hatchery road). In addition to showing us the full picture of fish use at the adjacent treatment or control sites, information collected in the fish bypass reaches at these diversions has the added benefit of being useful for before-after comparisons in the event that future work is conducted at these diversion sites.

Finally, in addition to the sites in the treatment and control areas in the lower river, we are sampling 10 sites randomly located within the fish bearing portions of the Entiat River watershed to discern possible watershed-scale signals that could confound our lower-river experiment. According to the *Monitoring Strategy for the Upper Columbia Basin*, we would ideally be sampling 50 such randomly located sites but were unable to afford that level of effort in this initial year. We hope that other agency cooperators may be able to fill this gap in subsequent years. In addition to implementing *Monitoring Strategy* habitat protocols at these sites, we are also conducting tests of different monitoring approaches as part of the larger ISEMP program.

Survey Area

All treatment and control sites are located in a relatively short stretch of the Entiat River from river mile 3 to RM 7. Each site is 200 meters long and is benchmarked with flagging, rebar, and fence posts. Benchmarks have been mapped and flagged at the mid-point and end-points of each sampling unit and coordinates will be taken by GPS. At this time, only one treatment site has been benchmarked because the specific sites where the next two Bridge-to-Bridge treatments will occur have not yet been finalized. It is anticipated that this will be determined by summer 2006. Once the additional two project sites are identified, monitoring data collection will be started at these locations.

MAP

Survey Period

Streamflow in the Entiat River can vary greatly and strongly influence the timing of surveys. Data obtained from the U.S Geological Survey (USGS) station near the mouth of the Entiat River (mean daily values for 1997-2003) shows minimum flows of 156 cfs in February and maximum flows of 2183 cfs in June (USGS 2003). Previous surveying efforts in the Entiat River by NRCS staff have indicated that when flows are >200 cfs, it is difficult to safely wade across the river, and USFWS staff have indicated that flows >400 cfs are difficult to be effectively or safely snorkeled. Therefore, our monitoring schedule must be somewhat flexible according to flow and water visibility conditions. Favorable snorkeling conditions of $\leq$400 cfs flow can be expected, on average, to occur between late July and April. The timing of habitat survey work that requires wading will be dependent upon safe wading flows, which usually start to occur in August.

We plan to survey the randomly selected sampling units in the treatment and control reaches three times annually (approximately every four months). The first surveys began early August, 2005 (but may be conducted in July in subsequent years if flow conditions allow). The second survey period will occur in late October/early November. The third survey period will occur in late February to early March.

Complete snorkel surveys will be conducted during each of three sampling periods. Intensive surveys of habitat conditions, channel conditions, and riparian conditions will be conducted once per year in coordination with the July/August snorkel survey following protocols described in the Upper Columbia Monitoring Strategy (Hillman 2004). Two additional habitat surveys of limited scope will be conducted to support snorkel surveys in November and late February; during these surveys, basic channel dimensions (e.g. bankfull width, wetted widths, side channel dimensions and connections with the main channel) and snorkel survey benchmarks will be mapped and measured as will pool area and pool depths. Large woody debris and other longitudinal metrics will also be counted. Continuously recording water temperature meters will be deployed in treatment and control reaches and will be downloaded monthly.

Sampling Guidelines

Snorkel Surveys: Fish will be surveyed by direct observation using single-pass daytime and nighttime snorkeling per Hillman (2004). Up to five snorkelers will conduct the surveys in the mainstem river sampling units. The irrigation canal will be surveyed by two snorkelers. Up to five snorkelers may be needed to survey the re-established off channel habitat depending on the dimensions and complexity of that unit. Survey crews will enter the downstream end of the designated sampling unit and snorkel in an upstream direction to the end of that unit. Glow sticks or other visible markers will be affixed near the applicable benchmarks prior to each survey to assist crews in determining length of each sample unit.

All USFWS staff involved with this survey work will have prior nighttime snorkeling experience. All snorkeling will be done in dry suits to maximize comfort. Snorkelers will use hand-held Halogen lights to illuminate their respective survey area. Data will be recorded by each diver on a PVC cuff secured to their arm. Prior to surveying a sample unit, a measure of underwater visibility will be done using a salmonid silhouette. The maximum distance at which marks (i.e. parr-like) on the silhouette are visible will be recorded. This distance must be sufficient to clearly survey the areas between each snorkeler and/or between snorkeler and the stream bank. Water temperature will be taken at the start of each survey.

All fish observed will be counted by species and assigned to a size/age class. Fish densities are tallied separately by habitat unit within each site.

Habitat Surveys: Surveys of habitat conditions, channel conditions, and riparian conditions will be conducted following protocols described in the Upper Columbia Monitoring Strategy (Hillman 2004) by staff previously trained and experienced in using

these protocols. Macroinvertebrate (aquatic insect) communities will be sampled at each sample site per Hillman (2004).

References

CCCD. 2004. Entiat Water Resource Inventory Area (WRIA) 46 Management Plan. October 2004. Prepared for the Entiat Watershed Planning Unit by the Chelan County Conservation District. Wenatchee, Washington.

Hillman, T.W. 2004. Monitoring strategy for the Upper Columbia Basin: Draft report February 1, 2004. Prepared for Upper Columbia Regional Technical Team, Wenatchee, Washington.